JC09 Rec'd PCT/PTO 27 FEB 2001

FORM PTO-1390 (REV. 11-2000) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: JP919980098PCT (590.051)

U S APPLICATION NO (If known, see 37 CFR 1 5): 09/763988

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP98/05355	25 November 1998	27 August 1998

TITLE OF INVENTION: SYSTEM AND METHOD FOR EMBEDDING ADDITIONAL INFORMATION IN VIDEO DATA

APPLICANT(S) FOR DO/EO/US: Koichi KAMIJO, Shuichi SHIMIZU, and Norishige MORIMOTO

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [ ] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [X] is attached hereto (required only if not communicated by the International Bureau).
   b. [X] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. [X] is attached hereto.
   b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [ ] Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   b. [ ] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] An English lanugage translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [ ] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. [ ] A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. [ ] A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. [ ] Other items or information:

U.S. APPLICATION NO (If known, see 37 CFR 1.5) 09/763988	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER

21. [X] The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1000.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$860.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**

International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**

International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**

CALCULATIONS PTO USE ONLY

ENTER APPROPRIATE BASIC FEE AMOUNT = $ 860

Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)). $

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	37 - 20 =	17	x **$18.00**	$ 306
Independent claims	11 - 3 =	8	x **$80.00**	$ 640
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$270.00**	$

TOTAL OF ABOVE CALCULATIONS = $1,806

[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2. + $

SUBTOTAL = $

Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). $

TOTAL NATIONAL FEE = $1,806

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property + $

TOTAL FEES ENCLOSED = $1,806

Amount to be refunded: $

charged: $

a. [ ] A check in the amount of $ _____ to cover the above fees is enclosed.

b. [X] Please charge my Deposit Account No. 50-0510 in the amount of $1,806 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-0510 A duplicate copy of this sheet is enclosed.

d. [ ] Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

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Stanley D. Ference III
NAME

33,879
REGISTRATION NUMBER

09/763988

JC03 Rec'd PCT/PTO 27 FEB 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	: Koichi KAMIJO et al.		
Serial No.	: Unassigned	Examiner :	Unassigned
Filed	: Herewith	Art Unit :	Unassigned
For	: SYSTEM AND METHOD FOR EMBEDDING ADDITIONAL INFORMATION IN VIDEO DATA		

February 27, 2001

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

Preliminary to the examination thereof, please amend the above-identified application as follows:

In the Claims:

Please cancel Claims 1-14 without prejudice.

Please add the following new claims:

--15. A system for embedding additional information in video data, said system comprising:

means for detecting a video frame in the video data;

means for extracting data for a small domain from said detected video frame and for buffering said data;

means for embedding additional information in said buffered small domain data without changing the length of the video data stream; and

means for returning said small domain, in which said additional information has been embedded, to said video data.--

--16. The system according to claim 15, wherein said video data is MPEG video data.--

--17. The system according to claim 16, wherein said video frame is an intra-macroblock of an I-frame, or of a P or B-frame.--

--18. The system according to claim 17, wherein said means for embedding said additional information includes:

means for detecting a DC factor in said buffered small domain;

means for determining whether the bit length of said DC factor will be unchanged even when said additional information has been embedded; and

means for embedding said additional information in said buffered small domain , when said bit length will be unchanged.--

--19. The system according to claim 18, wherein said means for embedding said additional information further includes:

means for determining whether 1/2 of said additional information can be embedded when said bit length will be changed, and for embedding said 1/2 of said additional information in said small domain when embedding is feasible.--

--20. The system according to claim 19, wherein said additional information is an embedding pattern obtained using a pseudorandom number.--

--21. The system according to claim 20, wherein said small domain is one macroblock domain.--

--22.. A system for detecting additional information in video data, said system comprising:

means for detecting a video frame in video data;

means for extracting data for a small domain from said video frame that is detected, and for buffering some data; and

means for detecting additional information in said small domain that is buffered.--

--23. A method for embedding additional information in video data, said method comprising the steps of:

detecting a video frame in video data;

extracting data for a small domain from said detected video frame and buffering said data;

embedding additional information in said buffered small domain without changing the length of the video data stream; and

returning said small domain, in which said additional information has been embedded, to said video data.--

--24. A method for embedding an electronic watermark in an MPEG stream, said method comprising the steps of:

detecting an intra-macroblock of an I-frame, or a P or B-frame, in an MPEG stream;

extracting data for one macroblock from said MPEG stream and buffering said data when said intra-macroblock of said I-frame, or said P or B -frame, is detected;

embedding an embedding pattern in said buffered macroblock without changing the length of VLC; and

returning said macroblock, in which said embedding pattern has been embedded, to said MPEG stream.--

--25. A method for detecting additional information in video data, said method comprising the steps of:

detecting a video frame in video data;

extracting data for a small domain from said video frame that is detected, and buffering said data; and

detecting additional information in said small domain that is buffered.--

--26. A method for detecting an electronic watermark in an MPEG stream, said method comprising the steps of:

detecting an intra-macroblock of an I-frame or a P or B-frame in an MPEG steam;

extracting data for one macroblock from said MPEG stream and buffering said data when said intra-macroblock of said I-frame or said P or B -frame is detected; and

detecting a pattern that is embedded in a DC factor in said macroblock that is buffered.--

--27. A system for controlling the copying of digital data, said system comprising:

means for detecting CCI in input data;

means for, when said CCI is detected, detecting ECCI in said input data;

means for, when said ECCI is detected, inhibiting the copying of the digital data; and

means for, when said ECCI is not detected permitting the embedding of said ECCI in said digital data and the copying of the resultant digital data.--

--28. A storage medium on which a program for embedding additional information in video data, said program comprising:

a function for detecting a video frame in video data;

a function for extracting data for a small domain from said detected video frame and for buffering said data;

a function for embedding additional information in said buffered small domain without changing the length of the video data stream; and

a function for returning said small domain, in which said additional information has been embedded, to said video data.--

--29. A storage medium for storing a program for detecting additional information in video data, said program comprising:

a function for detecting a video frame in video data;

a function for extracting data for a small domain from said video frame that is detected, and for buffering said data; and

a function for detecting additional information in said small domain that is buffered.--

--30. An apparatus for embedding additional information in video data comprising:

means for detecting a video frame in the video data;

means for extracting data for a small domain from said detected video frame and for buffering said data;

means for embedding additional information in said buffered small domain data without changing the length of the video data stream; and

means for returning said small domain, in which said additional information has been embedded, to said video data.--

--31. The apparatus according to claim 30, wherein said video data is MPEG video data.--

--32. The apparatus according to claim 31, wherein said video frame is an intra-macroblock of an I-frame, or of a P or B-frame.--

--33. The apparatus according to claim 32, wherein said means for embedding said additional information includes:

means for detecting a DC factor in said buffered small domain;

means for determining whether the bit length of said DC factor will be unchanged even when said additional information has been embedded; and

means for embedding said additional information in said buffered small domain , when said bit length will be unchanged.--

--34. The apparatus according to claim 33, wherein said means for embedding said additional information further includes:

means for determining whether 1/2 of said additional information can be embedded when said bit length will be changed, and for embedding said 1/2 of said additional information in said small domain when embedding is feasible.--

--35. The apparatus according to claim 34, wherein said additional information is an embedding pattern obtained using a pseudorandom number.--

--36. The apparatus according to claim 35, wherein said small domain is one macroblock domain.--

--37. An apparatus for detecting additional information in video data, comprising:

means for detecting a video frame in video data;

means for extracting data for a small domain from said video frame that is detected, and for buffering some data; and

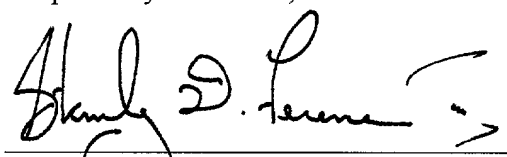
means for detecting additional information in said small domain that is buffered.--

JP9199980098PCT 590.051

REMARKS

Claims 1-15 as translated into the English language have been canceled. New Claims 16-37 have been added. Claims 16-29 generally correspond to Claims 1-15, however, Claims 16-29 appear in a format typically used in U.S. practice. No change in scope is intended. Claims 30-37 are newly added apparatus claims.

Respectfully submitted,



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Description

SYSTEM AND METHOD FOR EMBEDDING ADDITIONAL INFORMATION IN VIDEO DATA

Field of the Invention

The present invention relates to a technique for the embedding of additional information in a video data stream, and in particular to a method and a system for electronically embedding information in MPEG2 video data without changing the length of the VLC (Variable Length Code) that constitutes the MPEG video data portion.

Background Art

The data hiding technique (trademark of IBM) is known as a technique for embedding invisible and inseparable data in still picture data, and moving picture data or audio data. This technique is also called electronic watermarking and has received attention as a technique that can be used to protect copyrights for the contents of multimedia applications. Recently, since digital data have come to be widely employed for moving pictures which have in turn been widely distributed, and since the need for copyright protection has increased for the high value added contents of such applications as movies, the use of data hiding for the control of copying and replaying has been discussed. For embedding additional information in a digital image, generally the information is embedded in a baseband and then JPEG/MPEG compression is performed on the resultant data. Here it should be noted that JPEG is used to represent the Joint Photographic Coding Experts Group, and that MPEG is used to represent the Moving Picture Experts Group.

An electronic watermarking technique for still picture data, moving picture data or audio data is disclosed in, for example, Japanese Patent Application No. Hei 8-159330 (Our docket No. JA9-96-044), Japanese Patent Application No. Hei 8-273551 (Our docket No. JA9-96-076), Japanese Patent Application No. Hei 8-348426 (Our docket No. JA9-96-090), Japanese Patent Application No. Hei 9-088493 (Our docket No. JA9-97-045), Japanese Patent Application No. Hei 9-248272 (Our docket No. JA9-97-156), and Japanese Patent Application No. Hei 8-272721 (Our docket No. JA9-96-074). In all the cited prior art, embedding of image data in a baseband is assumed. Even for the embedding of the data contents that are compressed by JPEG/MPEG, generally the data are embedded in the baseband and then the resultant data are compressed, and the data are not directly embedded in a MPEG2 video data stream. This is because the length of the VLC (Variable length Code) would be changed by directly embedding image data in a compressed MPEG2 video data stream, and thus a content packet can not be coped with.

More specifically, since an AC or DC factor is changed using the VLC, the demultiplexing and the multiplexing of the VLC is required before and after the embedding process, so that the entire length of a bit stream is changed. Therefore, a large buffer is required and reconstruction of the bit stream is difficult. Particularly when DVD data are formed into a packet having a fixed length, the reconstruction of the packet is very difficult. Proposed in Japanese Patent Application No. Hei 8-272721 (Our docket No. JA9-96-074) is a method for

directly embedding data in a MPEG2 domain using the forward prediction and backward prediction for a B or P frame. This method also has the same shortcomings in that the length of the VLC is changed and moving picture data having a few B or P frames can not be coped with.

Problems to be Solved by the Invention

It is, therefore, one object of the present invention to provide a method and system for embedding additional information directly in video data.

It is another object of the present invention to provide a method and system for embedding additional information in a packet of video data.

It is an additional object of the present invention to provide a method and system for embedding additional information in MPEG data without changing the length of the VLC.

It is a further object of the present invention to provide a method and system for embedding additional information in a video data stream without changing the overall length of the video data stream.

It is still another object of the present invention to provide a method and system for embedding additional information in video data without a large buffer being required.

It is a still additional object of the present invention to provide a method and a system, for embedding an electronic watermark in MPEG data, that can cope with a moving picture having a few B or P frames.

Summary of the Invention

To achieve the above objects, to embed additional information in video data, first a video frame is detected in the video data, and data in a small domain are extracted from the detected video frame and buffered. Additional information is embedded in the buffered small domain without changing the length of the video data stream, and the resultant small domain is returned to the video data.

As for MPEG video data, an intra-macroblock of an I-frame or of a P or B-frame is detected in an MPEG stream, and following the detection of an intra-macroblock of the I-frame or of the P or B-frame, data for one macroblock are extracted from the MPEG stream and buffered. An embedding pattern is embedded in the buffered macroblock without changing the length of VLC, and the resultant macroblock is returned to the MPEG stream. More specifically, a DC factor is extracted from the buffered macroblock, and a pseudorandom number is generated to produce an embedding pattern. Then, whether the bit length of the DC factor will not be changed by embedding the obtained embedded pattern is determined. When the bit length of the DC factor not be changed, the embedding pattern is embedded in the buffered macroblock. When the bit length will be changed, whether 1/2 of the embedding pattern can be embedded is determined. If possible, 1/2 of the embedded pattern is embedded in the macroblock.

To detect additional information in video data, first, a video frame is detected in video data, and data in a small domain are extracted from the detected video frame and buffered. Then, the additional information in the buffered small domain is detected. To detect an electronic watermark in an MPEG stream, first, an intra-macroblock of an I-frame or of a P or B-frame is detected. When the intra-macroblock of an I-frame or of a P or B-frame is detected, data for one macroblock are extracted from the MPEG stream and buffered. An embedding pattern that is generated using a pseudorandom number is detected in the DC factor in the buffered macroblock. It should be noted that the pseudorandom number used for embedding and detection is generated by using a common secret key M.

With this arrangement, additional information can be embedded in the video data or can be detected therein without changing the size of a data stream. In addition, additional information can be embedded by an inexpensive method that does not require a high-cost process such as DCT calculation. Since only a small buffer is required, accordingly, any delay is small. Further, this method can be applied to a packetized MPEG2 stream.

Preferred Embodiment

An explanation will be given for the preferred embodiment wherein the method of the present invention is employed to embed additional information in MPEG video data. A system for embedding/detecting additional information in an MPEG2 stream mainly comprises two components: an embedding apparatus, and a detection apparatus. The embedding apparatus and the detection apparatus employ a common secret key M. A detailed explanation will be given below for these two apparatuses.

* Embedding Apparatus

First, an embedding method will be explained. In this invention, as is shown in Fig. 1, there are four embedding patterns (P0, P1, P2 and P3), which are embedded as macroblock (16 × 16 pixels) units in a DC luminance factor of MPEG2 video data. For example, to embed P0, the DC factor for Y0 of the luminance factor of the macroblock is incremented by 1, the DC factor for Y1 is decremented by one, and the DC factors for Y2 and Y3 are unchanged. A P that corresponds to each macroblock is obtained using a pseudorandom number M(i,j). That is, embedding pattern P, which is allocated for slice_number = i(0 origin) and macroblock_number = j, is obtained as P = PM(i,j). Further, for MPEG2, the DC factor that is actually changed in the MPEG2 domain is $\Delta(M(i,j),Y)$ because of a difference in the luminance factors in the preceding sub-block (Y0 for Y1 and Y3 in the preceding macroblock for Y0). The embedding processing will now be described while referring to the flowchart in Fig. 2.

First at step 100, an intra-macroblock of an I-frame or of a P or B-frame is detected. When an MPEG2 video stream is detected in a data stream and the intra-macroblock of the I-frame or of the P or B-frame is detected, program control moves to step 200.

At step 200 data for one macroblock are buffered. Of the bit stream for one macroblock, the portion extending from the DC factor for Y0 to the DC factor for Y3 is stored. At steps 300 and 400, the bit lengths for DDSL (Variable length code) + DDD (dct_dc_size_luminance)

before and after the embedding process are calculated. When the bit lengths are equal, i.e., when for Y = 0, 1, 2, 3 the following equation is established,

$$Len(D(i,j,Y)) == (Len(D(i,j,Y) + \Delta(M(i,j),Y)) \quad \ldots (1),$$

PM(i,j) is embedded in the macroblock. D(i,j,Y) represents a difference in DC factors when slice_num = i, macroblock_num = j, and subblock_num = Y; $\Delta(k,Y)$ represents the increase in the factor difference between the embedding pattern k and Y; and Len(x) represents the bit length of DDSL+DDD when the DC factor difference is x. Len(x) is shown in Fig. 3. The subblock in which Len(0) = Len(1) = 3 and the DC factor difference is "0" can be changed to "1" or "-1" because the bit length will not be changed. However, the subblock having the DC factor difference of "4" can not be changed to "3" because the bit length will be changed. When equation (1) is not established, program control moves to step 500.

When the embedding can not be performed because the bit length differs before and after the embedding, at steps 500 to 700, whether half of the quantity of information can be embedded is determined. If possible, half of the quantity of information is embedded. That is, when P1 in Fig. 1 can not be embedded, whether or not P'_1 or P''_1 can be embedded is determined. If either P'_1 or P''_1 can be embedded, it is embedded. In other words, when for Y = 0, 1, 2, 3 the following equation is established,

$$Len(D(i,j,Y)) == Len(D(i,j,Y) + \Delta'(M(i,j),Y)) \text{ or}$$
$$Len(D(i,j,Y)) == Len(D(i,j,Y) + \Delta''(M(i,j),Y)) \quad \ldots (2),$$

P'M(i,j) or P''M(i,j) is embedded in the macroblock. $\Delta'(K,Y)$ and $\Delta''(K,Y)$ are increases in the factor difference between the embedding pattern K at Y for P'_K and P''_K. When equation (2) is not established, program control moves to step 700, whereat the macroblock embedding is abandoned. At step 800 a check is performed to determine whether the intra-macroblock of the I-frame or of the P or B-frame has been processed. When the process has not been completed, program control returns to step 200.

Fig. 4 is a block diagram illustrating the arrangement of the embedding apparatus. An input controller 100 receives data from a data bus, such as an ATA, and stores them in a line buffer 200. The line buffer 200 is used to store data received by the input controller 100. An intra-macroblock detector 300 for an I-frame or for a P or B-frame detects an MPEG2 video stream in data stored in the line buffer 200, and further detects an intra-macroblock for an I-frame or for a P or B-frame. A CCI detector 400 is used only when the present invention is mounted in a data hiding detection chip (DataHiding $_{TM}$ detection chip), and detects the CCI after the I-frame is detected by the intra-macroblock detector 300. The CCI detector 400 detects the CCI and issues an interrupt to a CPU. The above described blocks 100 to 400 function as the data hiding detection chip.

A macroblock buffer 500 is used to store data for one macroblock. A DC luminance factor detector 600 detects a DC luminance factor (Y = 0,1,2,3) in a macroblock. A pseudorandom

is permitted. When the result "ECCI is present" is obtained, recording is not permitted. When the method of the present invention is employed for the embedding and the detection of ECCI, the system that permits copying to be performed only once can be provided. Fig. 5 is a flowchart showing example processing performed by a system for the distribution of digital video data.

At step 510 digital video data are received by an STB (Set Top Box). When the data are transmitted to a recording device 570, at step 520 CCI is detected, and when the CCI is detected, at step 530 whether or not ECCI is present is determined. When ECCI is present (YES), at step 560 recording is inhibited. When ECCI is not present, at step 540 ECCI is embedded in the video data and at step 550 recording is performed.

The advantages of this system are:
1. ECCI can be embedded in the MPEG2 domain in real time, and a packet having a DVD format can be coped with;
2. ECCI can be detected even in a baseband after the MPEG2 data have been developed, or in an analog domain for which DA conversion has been performed;
3. ECCI can be embedded directly in the baseband; and
4. the accuracy of the ECCI detection is not deteriorated by the occurrence of an error across a communication path, which is a problem that afflicts the Token method disclosed in Japanese Patent Application No. Hei 9-088493.

Advantages of the Invention

According to the present invention, an MPEG electronic watermarking system can be provided whereby the size of a data stream after additional information has been embedded is the same as it was before the additional information was embedded. The method of the present invention can be applied for a packet in an MPEG2 stream, and can also be performed at a low cost, without a high-cost process, such as DCT calculation, being required. Since only a small buffer is required, any delay is accordingly small. In addition, an electronic watermark can be detected even in a baseband image for which MPEG2 data have been developed. Since the information is embedded in the baseband image, the watermark can be directly detected even when MPEG2 compression has been performed for the image data. The method of the present invention does not conflict with the conventional marking technique for an AC factor, and can coexist with it.

Brief Description of the Drawings

Fig. 1 is a diagram showing example embedding patterns used for the present invention.
Fig. 2 is a flowchart showing the embedding processing for the present invention.
Fig. 3 is a table showing example values for Len(x).
Fig. 4 is a block diagram showing an embedding apparatus according to the present invention.
Fig. 5 is a flowchart showing the processing for an example copying control system when the present invention is applied for digital video.

number generator 700 generates a pseudorandom number (M(i,j)) for an embedding pattern. Two bits are allocated for one macroblock. For MP@ML (720 ×480), 720/16*480/16*2 = 2700 bits are generated. A DC huffman table 800 (Table B.12 for ISO/IEC 31818-2) is used to store a DC luminance factor for MPEG2. A DC huffman length comparator 900 determines whether or not the bit length of DDSL+DDD for the DC luminance factor will be changed by embedding data. A DC re-embedding unit 1000 embeds a pattern that is obtained by the pseudorandom number generator 700 when the comparator 900 determines that the bit length will not be changed. An output controller 1010 returns the obtained macroblock to the bit stream and outputs the resultant bit stream. When the output controller 1010 does not perform re-embedding, the data received from the input controller are transmitted unchanged. The above described blocks 500 to 1010 have been newly added to the data hiding detection chip.

* Detection Apparatus

The detection processing is performed in the following manner. When an I-frame is detected, assuming that DC(i,j,Y) is defined as a DC luminance factor (i, j and Y being defined in the same manner as for the embedding apparatus), that P(M(i,j),Y) is defined as an embedding value of embedding pattern M(i,j) for Y, and that

$\Delta DC(i,j) = DC(i,j,0) - DC(i,j,1)$, $M(i,j) = 0$

$DC(i,j,0) - DC(i,j,2)$, $M(i,j) = 1$

$DC(i,j,1) - DC(i,j,0)$, $M(i,j) = 2$

$DC(i,j,2) - DC(i,j,0)$, $M(i,j) = 3$.

Then, when the embedding is not performed, it is expected that the following expression will be established:

$\Sigma_i \Sigma_j \Delta DC(i,j)/N \dashrightarrow 0$

(It should be noted that N represents the number of $\Delta DC(i,j)$s that are employed for the calculation of $\Sigma\Sigma$.) When embedding is performed, the value approaches a specific positive value A:

$\Sigma i \Sigma j \ \Delta DC(i,j)/N \dashrightarrow A > 0$.

When the standard deviation σ of $\Delta DC(i,j)$ is

$\sigma^2 = \Sigma i \Sigma j (\Delta DC(i,j) - < \Delta DC(i,j) >)^2/N$, and

when threshold $T < z$ while

$z = \Sigma i \Sigma j \Delta DC(i,j)/(\sigma * N)$,

the embedding is "Yes," and when $T \geq z$, the embedding is "No."

Embodiment

The control of digital video recording and replaying has been discussed by employing the data hiding technique. Of demands from the film business and the public appliance business, the implementation of a system is sought that can permit recording only one time for charge broadcasting via a satellite or a cable (see DVD CPTWG DHSG CFP Ver 1.). A system for controlling the frequencies for the copying of distributed digital data can be proposed as one embodiment of the present invention. This system can be provided by employing the following method.

When a recording device detects CCI = (1,0) (Copy Once) in digital data, an examination is made to determine whether new CCI (extended CCI, hereinafter referred to as ECCI) is present. When the result "ECCI is not present" is obtained, ECCI is embedded and recording

CLAIMS

1. A system for embedding additional information in video data comprising:
(1) means for detecting a video frame in video data;
(2) means for extracting data for a small domain from said detected video frame and for buffering said data;
(3) means for embedding additional information in said buffered small domain without changing the length of the video data stream; and
(4) means for returning said small domain, in which said additional information has been embedded, to said video data.

2. The system according to claim 1, wherein said video data is MPEG video data.

3. The system according to claim 2, wherein said video frame is an intra-macroblock of an I-frame or of a P or B-frame.

4. The system according to claim 3, wherein said means (3) for embedding said additional information includes:
(3a) means for detecting a DC factor in said buffered small domain;
(3b) means for determining whether the bit length of said DC factor will be unchanged even when said additional information has been embedded; and
(3c) means for, when said bit length will be unchanged, embedding said additional information in said buffered small domain.

5. The system according to claim 4, wherein said means (3) for embedding said additional information further includes:
(3d) means for, when said bit length will be changed, determining whether 1/2 of said additional information can be embedded, and for, when embedding is feasible, embedding said 1/2 of said additional information in said small domain.

6. The system according to claim 5, wherein said additional information is an embedding pattern obtained using a pseudorandom number.

7. The system according to claim 6, wherein said small domain is one macroblock domain (16 ? 16 pixels).

8. A system for detecting additional information in video data, comprising:
(1) means for detecting a video frame in video data;
(2) means for extracting data for a small domain from said video frame that is detected, and for buffering said data; and
(3) means for detecting additional information in said small domain that is buffered.

9. A method for embedding additional information in video data comprising the steps of:
(1) detecting a video frame in video data;
(2) extracting data for a small domain from said detected video frame and buffering said data;
(3) embedding additional information in said buffered small domain without changing the length of the video data stream; and

(4) returning said small domain, in which said additional information has been embedded, to said video data.

9. A method for embedding an electronic watermark in an MPEG stream comprising the steps of:
(1) detecting an intra-macroblock of an I-frame or a P or B-frame in an MPEG stream;
(2) extracting data for one macroblock from said MPEG stream and buffering said data when said intra-macroblock of said I-frame or said P or B-frame is detected;
(3) embedding an embedding pattern in said buffered macroblock without changing the length of VLC; and
(4) returning said macroblock, in which said embedding pattern has been embedded, to said MPEG stream.

10. A method for detecting additional information in video data, comprising the steps of:
(1) detecting a video frame in video data;
(2) extracting data for a small domain from said video frame that is detected, and buffering said data; and
(3) detecting additional information in said small domain that is buffered.

11. A method for detecting an electronic watermark in an MPEG stream, comprising the steps of:
(1) detecting an intra-macroblock of an I-frame or a P or B-frame in an MPEG steam;
(2) extracting data for one macroblock from said MPEG stream and buffering said data when said intra-macroblock of said I-frame or said P or B-frame is detected; and
(3) detecting a pattern that is embedded in a DC factor in said macroblock that is buffered.

12. A system for controlling the copying of digital data, comprising:
(1) means for detecting CCI in input data;
(2) means for, when said CCI is detected, detecting ECCI in said input data;
(3) means for, when said ECCI is detected, inhibiting the copying of the digital data; and
(4) means for, when said ECCI is not detected, permitting the embedding of said ECCI in said digital data and the copying of the resultant digital data.

13. A storage medium on which a program for embedding additional information in video data, said program comprising:
(1) a function for detecting a video frame in video data;
(2) a function for extracting data for a small domain from said detected video frame and for buffering said data;
(3) a function for embedding additional information in said buffered small domain without changing the length of the video data stream; and
(4) a function for returning said small domain, in which said additional information has been embedded, to said video data.

14. A storage medium for storing a program for detecting additional information in video data, said program comprising:
(1) a function for detecting a video frame in video data;
(2) a function for extracting data for a small domain from said video frame that is detected, and for buffering said data; and

[Document Type] Abstract

[Abstract]

[Object]

It is one object of the present invention to provide a method and system for embedding an electronic watermark directly in an MPEG stream.

[Constitution]

An intra-macroblock of an I-frame or of a P or B-frame is detected in an MPEG stream, and following the detection of an intra-macroblock of the I-frame or of the P or B-frame, data for one macroblock are extracted from the MPEG stream and buffered. An embedding pattern is embedded in the buffered macroblock without changing the length of VLC, and the resultant macroblock is returned to the MPEG stream. More specifically, a DC factor is extracted from the buffered macroblock, and a pseudorandom number is generated to produce an embedding pattern. Then, whether the bit length of the DC factor will not be changed by embedding the obtained embedded pattern is determined. When the bit length of the DC factor not be changed, the embedding pattern is embedded in the buffered macroblock. When the bit length will be changed, whether 1/2 of the embedding pattern can be embedded is determined. If possible, 1/2 of the embedded pattern is embedded in the macroblock.

[Selected Drawing] Fig. 4

KR2000-0065209 A

09/763988

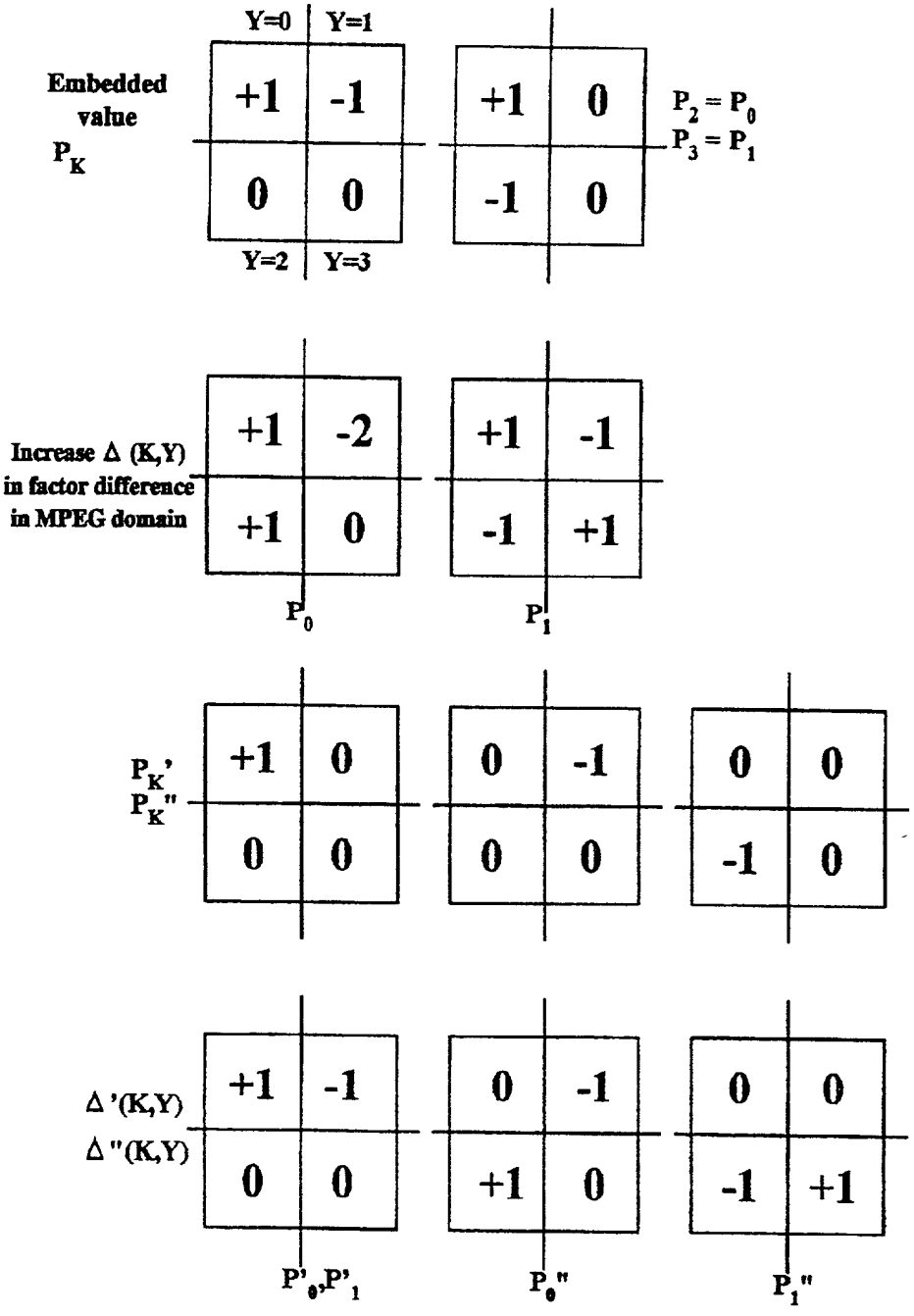

Fig. 1

09/763988

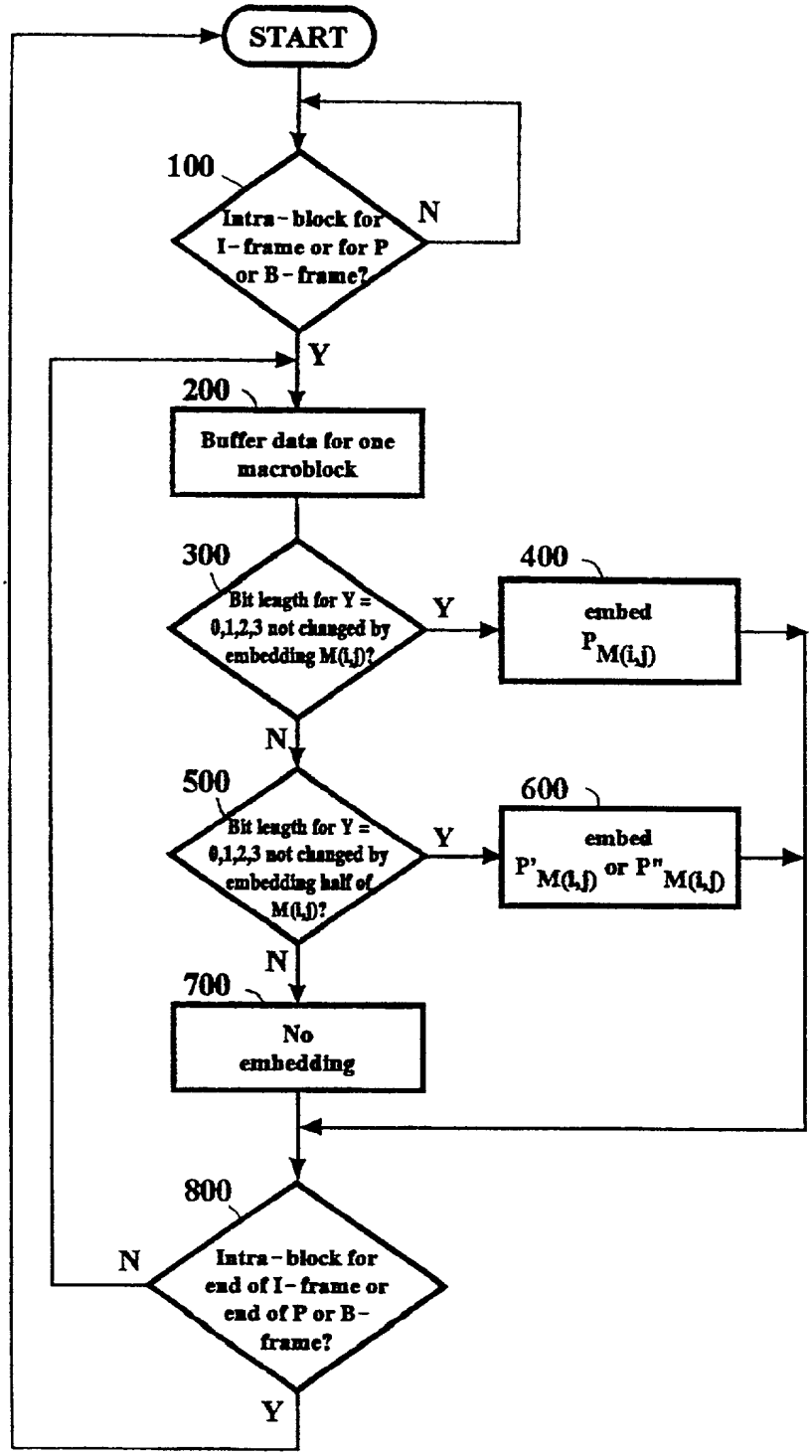

Fig. 2

09/763988

Len(x)	Variable length code	dct_dc_size_luminance	Change in DC
3	100	0	±0
3	00	1	±1
4	01	2	±2,3
6	101	3	±4, ... ,7
7	110	4	±8, ... ,15
9	1110	5	±16, ... ,31
11	1111 0	6	±32, ... ,63
13	1111 10	7	±64, ... ,127
15	1111 110	8	±128, ... ,255
17	1111 1110	9	±256, ... ,511
19	1111 1111 0	10	±512, ... ,1023
20	1111 1111 1	11	±1024, ... ,2047

Fig. 3

09/763988

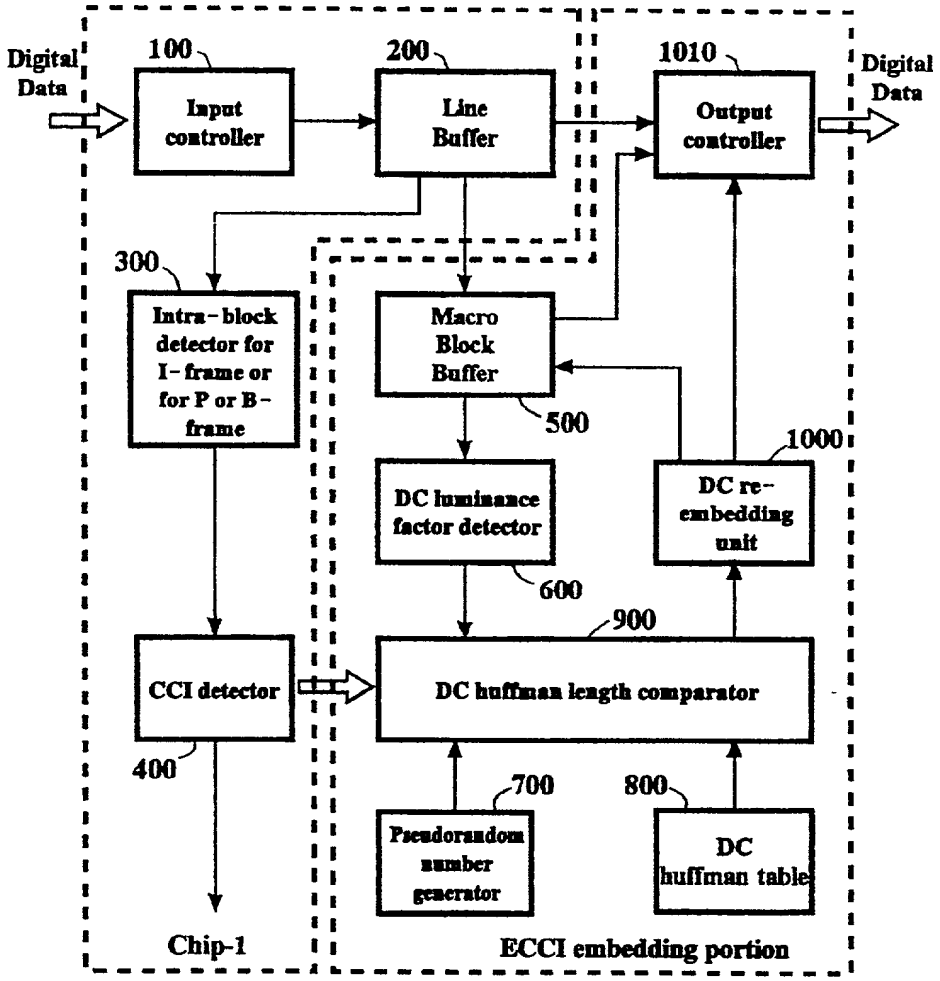

Fig. 4

09/763988

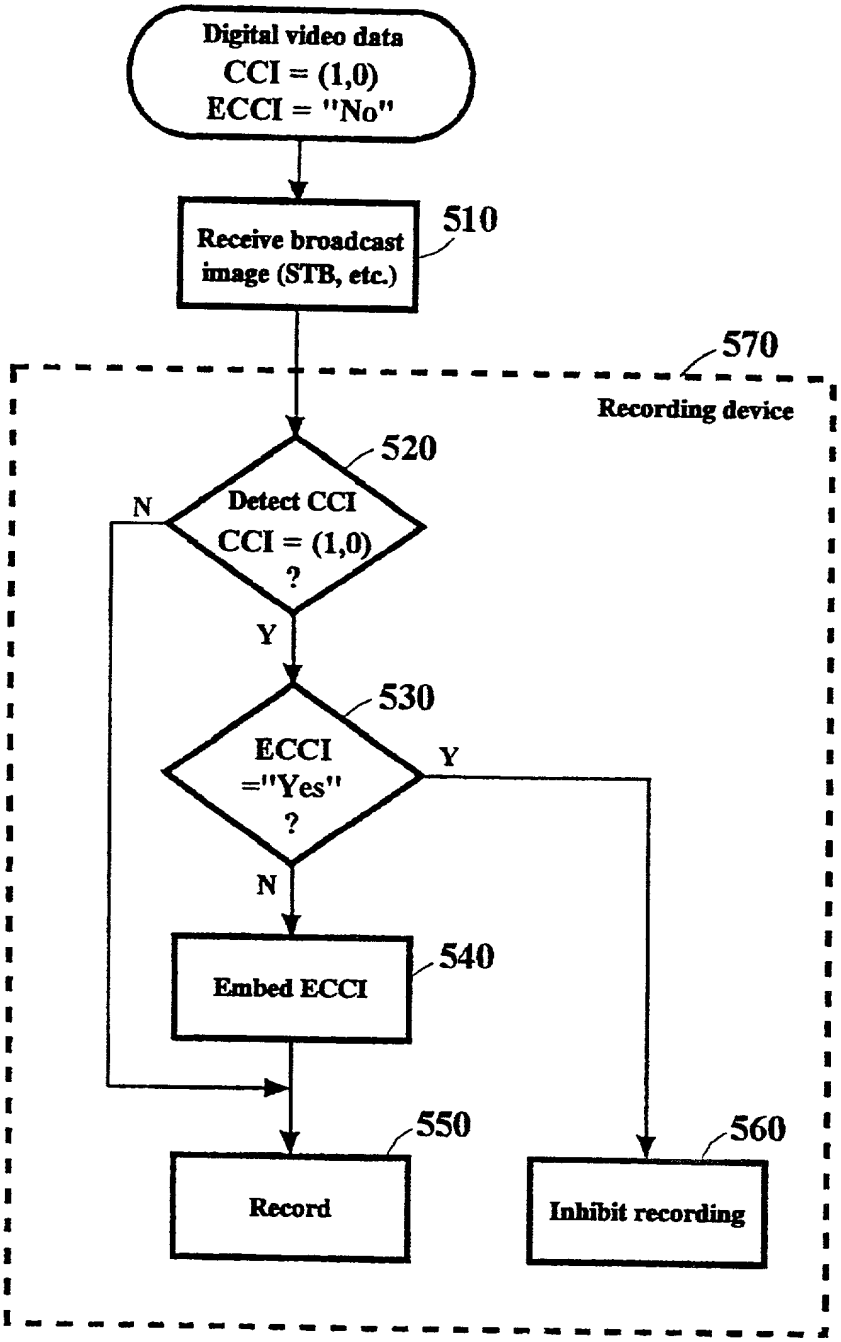

Fig. 5

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

(JP919980098PCT)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SYSTEM AND METHOD FOR EMBEDDING ADDITIONAL INFORMATION IN VIDEO DATA

the specification of which (check one)

____ is attached hereto.

__x__ was filed on __25 November 1998__ as International Business Machines Docket No. _____ or

PCT International Application No. __PCT/JP98/05355__ and was amended on __27 February 2001__ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application, having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)				Priority Claimed
10-241493 (Number)	JP (Country)	27 August 1998 (Day/Month/Year Filed)		x Yes ___ No
___ (Number)	___ (Country)	___ (Day/Month/Year Filed)	___	___ Yes ___ No
___ (Number)	___ (Country)	___ (Day/Month/Year Filed)	___	___ Yes ___ No

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

(Application Number)	(Filing Date)
(Application Number)	(Filing Date)

DELARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

I hereby claim the benefit under 35 U.S.C. §120 of any United States Application(s), or §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States, or PCT International application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose information material to the patentability of this application as defined in 37 CFR §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number).

19

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